


PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference F18762 LVDW		FOR FURTHER ACTION		See Form PCT/PEAA16
International application No. PCT/IB2005/050449		International filing date (day/month/year) 03.02.2005	Priority date (day/month/year) 05.02.2004	
International Patent Classification (IPC) or national classification and IPC INV. C10G200 C07C41/01 C07C41/09 C07C1/20				
Applicant SASOL TECHNOLOGY (PROPRIETARY) LIMITED				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 25 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 807 of the Administrative Instructions).</p> <p><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 02.12.2005		Date of completion of this report 14.07.2006		
Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer Seufert, G Telephone No. +49 89 2399-8330		



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

 International application No.
PCT/IB2005/050449

04 AUG 2006

Box No. I Basis of the report

1. With regard to the language, this report is based on
- ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3(a) and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4(a))
 - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a))
2. With regard to the elements* of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-21 received on 07.12.2005 with letter of 02.12.2005

Claims, Numbers

1-17 received on 07.12.2005 with letter of 02.12.2005

Drawings, Sheets

1/2, 2/2 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing *(specify):*
 - ☐ any table(s) related to sequence listing *(specify):*
4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☒ the claims, Nos. 1, 10
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing *(specify):*
 - ☐ any table(s) related to sequence listing *(specify):*

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/IB2005/050449

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or Industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-17
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-17
Industrial applicability (IA)	Yes: Claims	1-17
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

**INTERNATIONAL PRELIMINARY
 REPORT ON PATENTABILITY
 (SEPARATE SHEET)**

International application No.

PCT/IB2005/050449

Reference is made to the following documents:

- D1 GB-A-2092172
- D2 GB-A-2097382
- D3 WO-A-0226676
- D4 Ullmann's Encyclopedia of Industrial Chemistry, vol. 8, 2003, pages 651-668
- D5 WO-A-02094426
- D6 US-A-2003/0018088

I. Basis of the opinion.

This opinion has been established as if the following amendments in claim 1 and claim 10 had not been made:

- 1) "which includes a slurry bed of solid particulate shifting catalysts suspended in a carrier liquid" (claim 1)
- 2) "at an overall CO and H₂ conversion of between 30% and 60%" (claim 1)
- 3) deletion of the overall CO and H₂ conversion for the Fischer-Tropsch reaction stage from claim 10

The applicant has provided page 2 and 4 as support for the amendments. Apparently, the applicant refers to page 2, lines 1-3 and page 4, lines 30-34. However, on page 2, lines 1-3 the slurry bed is mentioned in combination with the feeding of the gas at a low level, and on page 4 the conversion has been disclosed in combination recycling of the tail gas, which was also reflected in the original claim 10. The applicant has picked only one feature from the disclosed combinations and introduced them into claim 1. This is considered to go beyond the disclosure as originally filed (Rule 70.2(c) PCT). The amendments in claim 1 and 10 have therefore been disregarded.

V. Reasoned Statement with regard to novelty, inventive step and industrial applicability

Novelty

The present application refers to a process for co-producing hydrocarbons and dimethyl ether (DME), the process including feeding a gaseous feedstock comprising hydrogen and carbon monoxide, into a three-phase low temperature catalytic Fischer-Tropsch reaction stage; allowing the hydrogen and carbon monoxide partially to react catalytically in the Fischer-Tropsch reaction stage to form hydrocarbons; obtaining a tail gas from the Fischer-Tropsch reaction stage which includes unreacted hydrogen and carbon monoxide and also carbon dioxide; adjusting the composition of at least a portion of the tail gas to provide a DME synthesis feedstock with a syngas number (SN) between 1.8 and 2.2, where

$$SN \text{ is equal to } [H_2] - [CO_2]/[CO] + [CO_2]$$
 and where $[H_2]$, $[CO]$ and $[CO_2]$ respectively are the molar proportions of hydrogen, carbon monoxide and carbon dioxide in the DME synthesis feedstock; feeding the DME synthesis feedstock into a DME synthesis stage; and converting at least a portion of the DME synthesis feedstock fed to the DME synthesis stage to DME (claim 1).

None of the available documents describes a process with all the technical features of claim 1. Thus, claim 1 and the dependent claims 2-14 appear to meet the requirement of Art. 33(2) PCT.

Claim 15 refers to a process for co-producing a liquid fuel and light olefins, the process including co-producing liquid hydrocarbons and dimethyl ether (DME) according to the process of claims 1-14 from a gaseous feedstock comprising hydrogen and carbon monoxide; treating the liquid hydrocarbons to provide a liquid fuel; and converting at least some of the DME into light olefins. The claim comprises the steps of claim 1 and since the subject-matter of claim 1 appears to be novel, the present claim 15 as well as claims 16 and 17 may equally be considered as fulfilling the requirement of Art. 33(2) PCT.

Inventive step

Document D1 (or D2) may be considered as the most relevant state of the art. The presently claimed process according to claim 1 is distinguished from the state of the art mainly in that the sequence of the Fischer-Tropsch- and DME-synthesis steps has

been changed. The present claim 1 refers to a Fischer-Tropsch synthesis step followed by a DME synthesis step with the tail gas of the Fischer-Tropsch reaction comprising the unreacted syngas, while D1 discloses first the production of DME followed by the Fischer-Tropsch synthesis step using the tail gas of the DME production, which comprises the unreacted syngas. Furthermore, D1 already recognises that the syngas mixture suitable for the Fischer-Tropsch reaction differs from the syngas mixture useful to provide DME, i.e. for the best performance the syngas mixture should be adjusted for each step in order to provide the most suitable mixture.

The technical advantages achieved in the present application, i.e. a high conversion of syngas to the desired products, are the same as in D1, cf. the examples 3, 5-8 of D1 and the examples of the present application.

The problem to be solved by the present invention may therefore be considered as providing an alternative process for the production of hydrocarbons and DME.

The problem has been solved by the presently claimed process of claim 1, whereby the hydrocarbon and the DME synthesis steps have been interchanged.

The mere change in the sequence of steps is generally not considered as involving an inventive step. Both process steps, i.e. the Fischer-Tropsch and the DME synthesis step, use syngas to produce valuable compounds and unreacted syngas. Using the unreacted syngas from one step in the other step has been demonstrated in D1. It would be obvious for the skilled person that the sequence of the steps could be interchanged, as long as the syngas mixture is suitable for the required step. The requirement for adjusting the syngas mixture for each of the single steps has already been acknowledged in D1. The requirement of a syngas number between 1.8 and 2.2 is already known as advantageous in the production of methanol, see D3, page 3, lines 21-23, page 7, line 30 - page 8, line 19, which is the first compound to be produced in the DME-synthesis. Keeping the syngas number in the aforementioned range is therefore considered to be obvious for the skilled person. Consequently, the subject-matter of claim 1 does not fulfill the requirement of Art. 33(3) PCT.

The applicant's arguments have been considered, however, the aforementioned objection is maintained. It has been understood that the applicant does not consider the documents D1 or D2 as the closed prior art documents. In view of the applicant's argumentation, he seems to consider the Fischer-Tropsch process alone as closest prior art, from which using the problem solution approach the problem to be solved was to provide an improved process, which avoids the disadvantages of the Fischer-Tropsch process.

However, the present claim is concerned with the co-production of hydrocarbons and dimethylether using a combination of a Fischer-Tropsch and a DME synthesis stage, which is exactly the same as in D1/D2. D1 or D2 are therefore considered to represent the closest prior art. The technical advantages are the same. Thus, the problem is the provision of an alternative process. As mentioned above changing the reaction steps is usually not considered to require inventive skills, if no surprising or unexpected effect results from this change. Such an effect is not apparent.

It has been correctly pointed out by the applicant that the steps may not merely be swapped, because the Fischer-Tropsch and the DME synthesis stage may require different proportions of CO, H₂ and CO₂. However, this is known to the skilled person. Both reactions are well known in the art, and so is the necessity to use the best proportions of CO, H₂ and CO₂ for each step. This has also been acknowledged in D1. The skilled person does not need inventive skills to adjust the CO, H₂ and CO₂ proportion, if this would be required by changing the reaction steps. Claim 1 is therefore not considered to meet the requirement of Art. 33(3) PCT.

The subject-matter of the dependent claims 2-14, is also not considered to meet the requirement of Art. 33(3) PCT for the following reasons:

The features mentioned in the dependent claims are either obvious for the skilled person (for example if a certain amount of carbon monoxide, hydrogen and carbon dioxide is known to be required, it would be obvious for the skilled person to remove or add individual components in order to adjust a mixture in such a way as to achieve the required amount) or generally known in the area (for example the recycling of streams, or the upgrading of Fischer-Tropsch reaction products, or the use of naphtha as feedstock for the production of light olefins, see D4 and D5, and also D1 and D2).

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/IB2005/050449

The subject-matter of claim 15 is not considered to meet the requirements of Art. 33(3) PCT, because the process of claim 1 to which claim 15 refers is not considered to be inventive. The additional feature of treating the liquid hydrocarbons to provide a liquid fuel, which includes for example hydroprocessing steps or dewaxing steps, is well known in the art, see for example D4-D6 and is even suggested in D1 (or D2). It can therefore not support an inventive step. Naphtha is known to be an ideal feedstock for cracking to olefins (see D4, page 651, right column, lines 25-26). Claim 15 and the dependent claims 16-17 are therefore not considered to meet the requirement of Art. 33(3) PCT.

Industrial applicability

There are no objections against the industrial applicability of claims 1-17.

Further remarks:

It should be noted that for the present opinion the term "includes" has been interpreted as "comprising".